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(54) Color picture tube having an inline electron gun

(57) The present invention relates to a color picture tube having a viewing screen and an electron gun (26) within a neck (14) of the tube for generating and directing three inline electron beams, a center beam and two side beams, toward the screen. The electron gun includes a plurality of electrodes including a focus electrode (G5). The tube neck is adapted for receipt of a surrounding scan velocity modulation coil (54, 56) at a location thereon. The focus electrode includes two spaced parts (44, 46) that are electrically connected and adapted for connection to the same focus voltage (V_{FOCUS}). The space (45) between the parts is surrounded by the neck location for the coil.

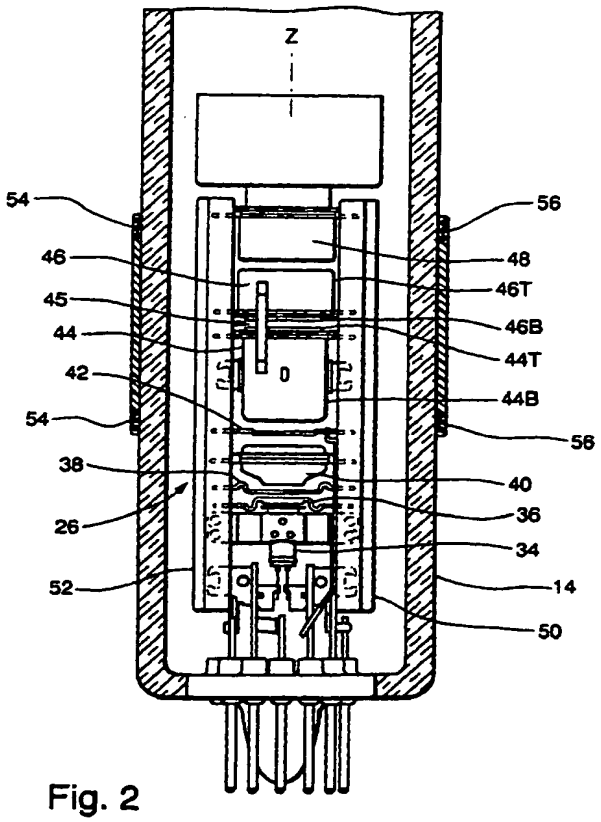


Fig. 2

EP 0 889 500 A1

Description

The present invention relates to improved color picture tubes having inline electron guns, and particularly to a tube having an inline electron gun that includes a split focus electrode.

For a color picture tube, the resolution of a picture is dependent upon having small electron beam spot sizes at the tube viewing screen. In such a tube, an electron gun generates three electron beams, which must be simultaneously focused to small spots on the screen. It is known to use coils on the neck of a tube to provide scan velocity modulation (SVM). A SVM coil is a two-pole device aligned to produce vertical magnetic fields, which induce horizontal deflection of the electron beams. Such coils improve the image quality of a tube by modulating the horizontal deflection velocity of the electron beams. The SVM coil is driven as a function of the video signal. As video rate increases, such as from the NTSC rate to VGA and SVGA rates, the SVM coil should be operated at correspondingly higher frequencies. These higher frequencies result in rapidly changing magnetic fields. According to Faraday's law of induction, the changing magnetic flux will generate internal closed-loop current pathways in any conductor. Additionally, Lenz's law states that the induced eddy currents will produce a flux of magnetic induction which opposes the change in the incident field, thus reducing the magnitude of the magnetic field reaching the electron beams. The magnitude of these currents is dependent on the rate of change of the flux, i.e., frequency. This reduction of the magnetic field necessitates higher power circuits or higher sensitivity coils, and therefore result in undesirable higher cost.

The present invention relates to a color picture tube having a viewing screen and an electron gun within a neck of the tube for generating and directing three inline electron beams, a center beam and two side beams, toward the screen. The electron gun includes a plurality of electrodes including a focus electrode. The tube neck is adapted for receipt of surrounding scan velocity modulation coils at a location thereon. The focus electrode includes two spaced parts that are electrically connected and adapted for connection to the same focus voltage. The space between the parts is surrounded by the neck location for the coils. This space provides an eddy current-free region, thus increasing the resultant magnetic field seen by the electron beams.

In the drawings:

FIGURE 1 is a plan view, partly in axial section, of a color picture tube embodying the invention.

FIGURE 2 is a side view, partly in axial section, of the electron gun of FIGURE 1, positioned in the tube neck with SVM coils located on the neck.

FIGURE 3 is a schematic view of the electron gun of FIGURE 2, showing the electrical connections of the electrodes of the electron gun.

FIGURE 4 is a front view of the side of a G5B electrode part that opposes a G5T electrode part in the electron gun of FIGURE 2.

FIGURE 5 is a front view of the side of the G5B electrode part that opposes the G5T electrode part in an alternative electron gun.

FIGURE 1 shows a rectangular color picture tube 10 having a glass envelope 11 comprising a rectangular faceplate panel 12 and a tubular neck 14 connected by a rectangular funnel 15. The funnel 15 has an internal conductive coating (not shown) that extends from an anode button 16 to the neck 14. The panel 12 comprises a viewing faceplate 18 and a peripheral flange or sidewall 20, which is sealed to the funnel 15 by a glass frit 17. A three-color phosphor screen 22 is carried by the inner surface of the faceplate 18. The screen 22 is preferably a line screen with the phosphor lines arranged in triads, each triad including a phosphor line of each of the three colors. Alternatively, the screen can be a dot screen. A multi-apertured color selection electrode or shadow mask 24 is removably mounted, by conventional means, in predetermined spaced relation to the screen 22. An electron gun 26, shown schematically by dashed lines in FIGURE 1, is centrally mounted within the neck 14 to generate and direct three electron beams along convergent paths through the mask 24 to the screen 22.

The tube of FIGURE 1 is designed to be used with an external magnetic deflection yoke (not shown) that is attached to the tube in the neighborhood of the funnel-to-neck junction. When activated, the yoke subjects the three beams to magnetic fields which cause the beams to scan horizontally and vertically in a rectangular raster over the screen 22.

The details of the electron gun 26 are shown in FIGURES 2, 3 and 4. The gun 26 comprises three spaced inline cathodes 34 (only one of which is shown), a control grid electrode 36 (G1), a screen grid electrode 38 (G2), an accelerating electrode 40 (G3), a plate-shaped electrode 42 (G4), a focus electrode (G5) divided into two parts, 44 (G5B) and 46 (G5T), and a final electrode 48 (G6), spaced in the order named. Each of the G1 through G6 electrodes has apertures therein to permit passage of three electron beams. The electrostatic main focusing lens in the gun 26 is formed by the facing portions of the G5T electrode part 46 and the G6 electrode 48. The G5B electrode 44 and the G5T electrode are each formed by two pieces, 44B and 44T, and 46B and 46T, respectively.

All of the electrodes of the electron gun 26 are either directly or indirectly connected to two insulative support rods

50 and 52. Preferably, the support rods are of glass which has been heated and pressed onto claws extending from the electrodes, to embed the claws in the rods.

Shown on the neck 14 in FIGURE 2 are two scan modulation (SVM) coils 54 and 56. Each coil is somewhat rectangular and is contoured to conform to the cylindrical shape of the neck. Each coil also includes a large central window which are located opposite to each other on the top and the bottom of the neck. Although such SVM coils have been used on tubes having electron guns with fixed focus voltages, the present inventors have found that the effect of the SVM coils on these tubes can be increased by incorporating an additional space 45 within the electron gun to allow the SVM field to act on the electron beams in an unobstructed manner. The space 45 permits the rapidly changing flux created by the SVM coils to reach the electron beams without suffering the losses caused by the generation of eddy currents in the electrodes. This additional space 45 is formed by longitudinally separating the G5 focus electrode into two parts, the G5B electrode part 44 and the G5T electrode part 46. The coils should surround the space between the parts 44 and 46, but preferably, the space should be located closer to the longitudinal center of the coils than near their ends, as shown in FIGURE 2.

Electrical connections of the electrodes of the electron gun 26 are shown in FIGURE 3. The G1 electrode is connected to ground. The G2 and G4 are connected to each other and to the G2 voltage V_{G2}, the G3, G5B and G5T are all connected to each other and to a fixed focus voltage V_{FOCUS}, and the G6 is connected to the anode voltage V_{ANODE}.

In the electron gun 26, the facing pieces 44T and 46B of the two electrode parts 44 and 46, respectively, each include a single elongated aperture 47 therein, as shown for part 44T in FIGURE 4. The remote pieces 44B and 46T of the two electrode parts 44 and 46, respectively, include three apertures 60, 62 and 64 therein, for passage of the three electron beams, as shown for part 44T in FIGURE 4. FIGURE 5 shows an alternative embodiment of the parts 44T and 46B, designated with primes of the same items, respectively. This alternative embodiment shows how the shapes and sizes of all of the apertures in electrode parts 44 and 46 can be altered to obtain a particular level of performance. In the portion of the alternative embodiment shown in FIGURE 5, a larger elongated aperture 47' is included in the part 44T' and three larger apertures, 60' 62' and 64' are included in the part 44B'.

One set of electrode spacings for the electron gun 26 is given in the following table.

TABLE I

Spacing between cathode and G1 =	0.003" (0.076 mm)*
Spacing between G1 and G2 =	0.009" (0.229 mm)
Spacing between G2 and G3 =	0.030" (0.762 mm)
Spacing between G3 and G4 =	0.050" (1.270 mm)
Spacing between G4 and G5B =	0.050" (1.270 mm)
Spacing between G5B and G5T =	0.070" (1.778 mm)
Spacing between G5T and G6 =	0.050" (1.270 mm)

* at opertating temperature

Claims

1. A color picture tube (10) having a viewing screen (22), and an electron gun (26) within a neck (14) of said tube for generating and directing three inline electron beams, a center beam and two side beams, toward said screen, characterized by

   said electron gun including a plurality of electrodes including a focus electrode (G5), said focus electrode including two spaced parts (44, 46, 44') that are electrically connected and adapted for connection to the same focus voltage (V_{FOCUS}), wherein facing portions (44T, 46B) of said two spaced parts of said focus electrode each include three apertures (60, 62, 64, 60', 62' 64') therein for passage of the three electron beams, and in at least one of said two spaced parts, said three apertures are set back from a leading edge portion (43, 43') that forms a single elongated aperture (47, 47') therein for passage of the three electron beams.

2. A color picture tube (10) having a viewing screen (22), and an electron gun (26) within a neck (14) of said tube for generating and directing three inline electron beams, a center beam and two side beams, toward said screen, characterized by

said electron gun including a plurality of electrodes including a focus electrode (G5), said tube neck being surrounded by a scan velocity modulation coil (54, 56) at a location of the focus electrode, and said focus electrode including two spaced parts (44, 46, 44') that are electrically connected and adapted for connection to the same focus voltage (V_{FOCUS}).

3. The tube as defined in Claim 2, characterized by facing portions of said two spaced parts (44, 46, 44') of said focus electrode (G5) including each three apertures (60, 62, 64, 60', 62', 64') therein for passage of the three electron beams, and in at least one of said two spaced parts, said three apertures being set back from a leading edge portion (43, 43') that forms a single elongated aperture (47, 47') therein for passage of the three electron beams.

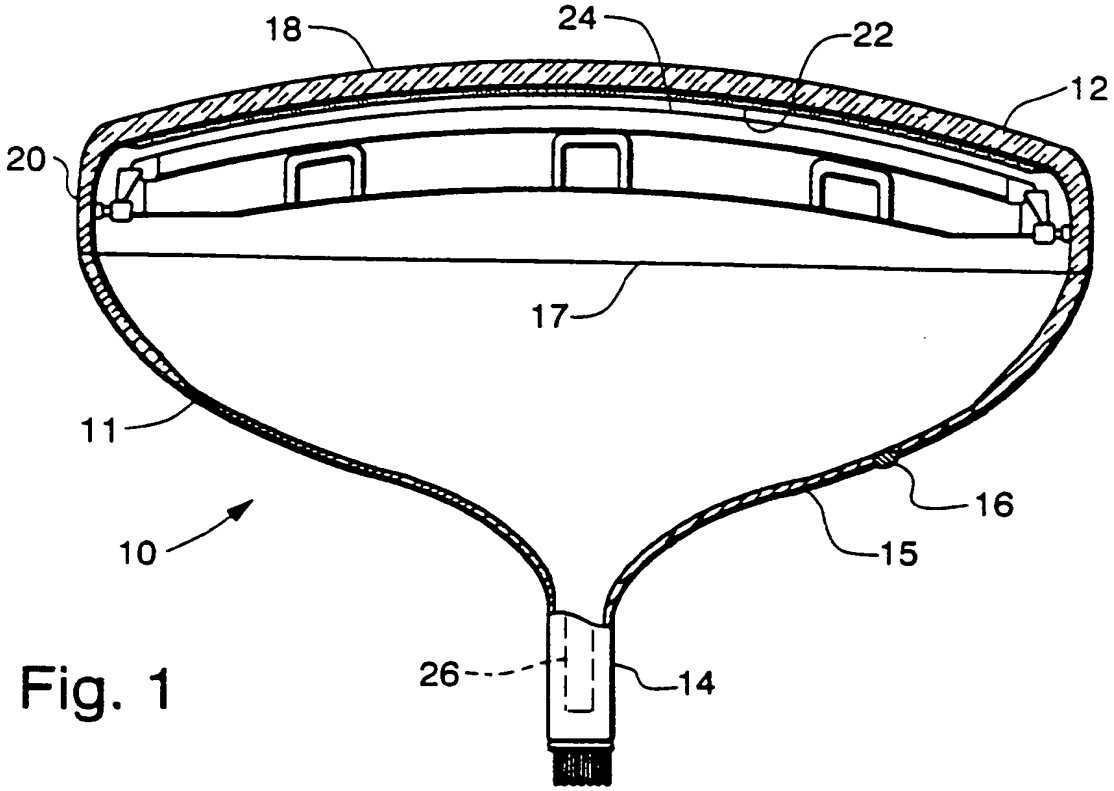


Fig. 1

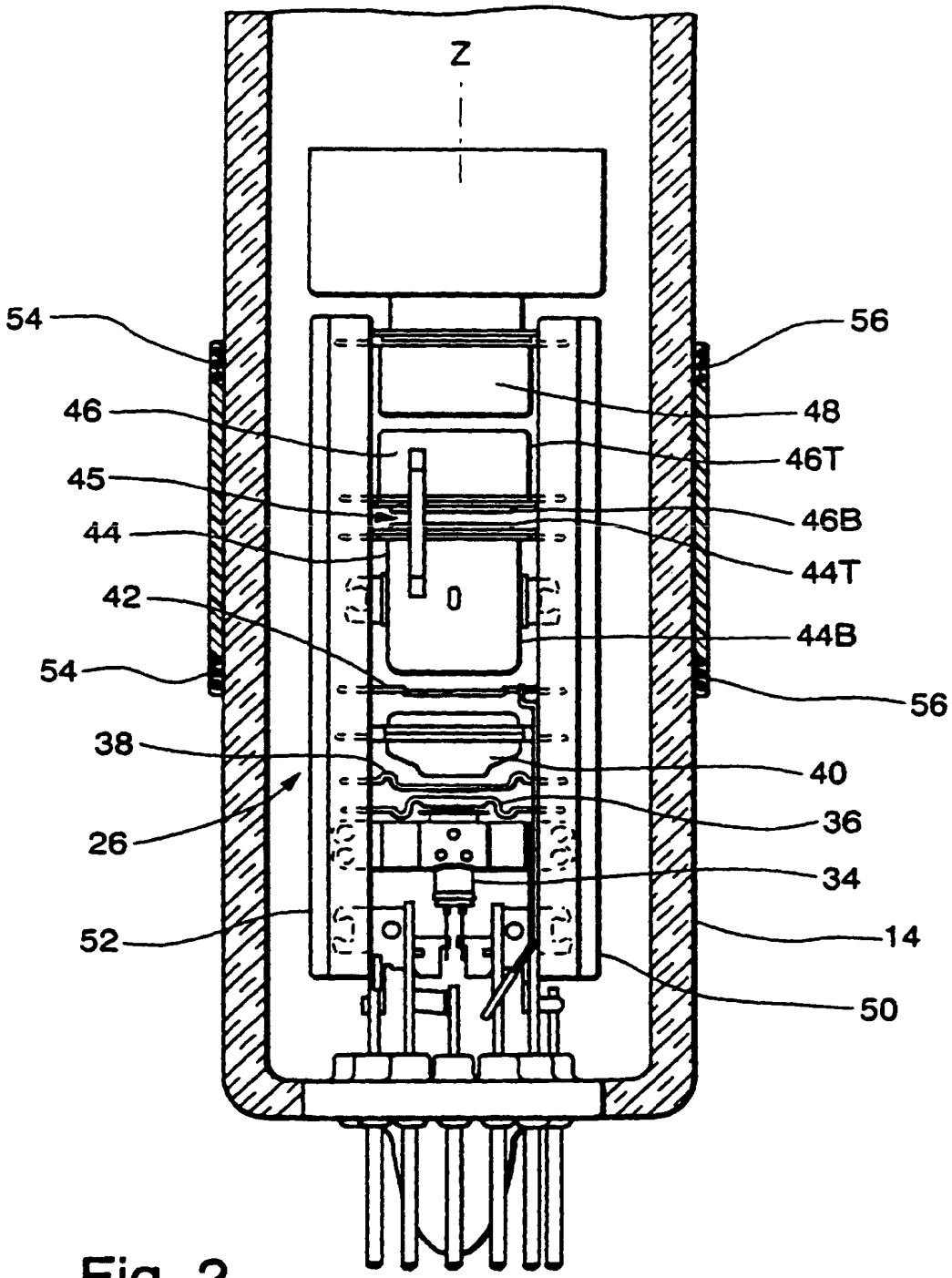
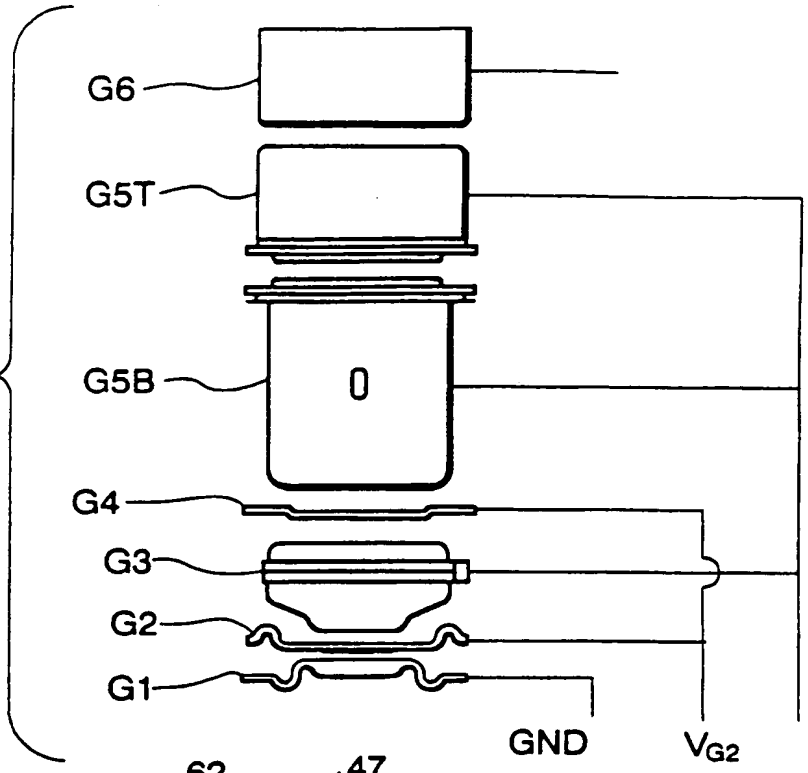


Fig. 2

Fig. 3



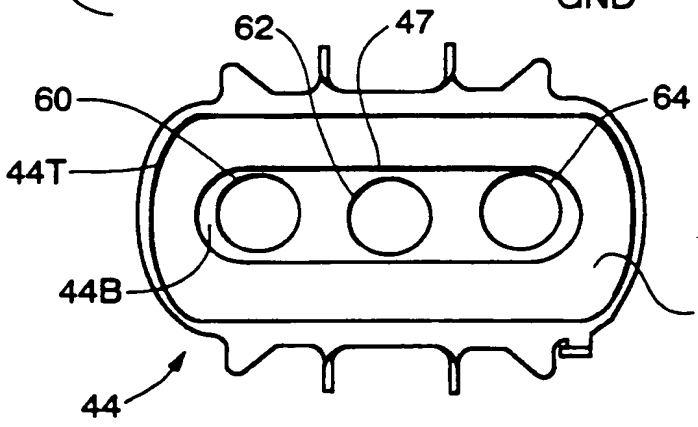


Fig. 4

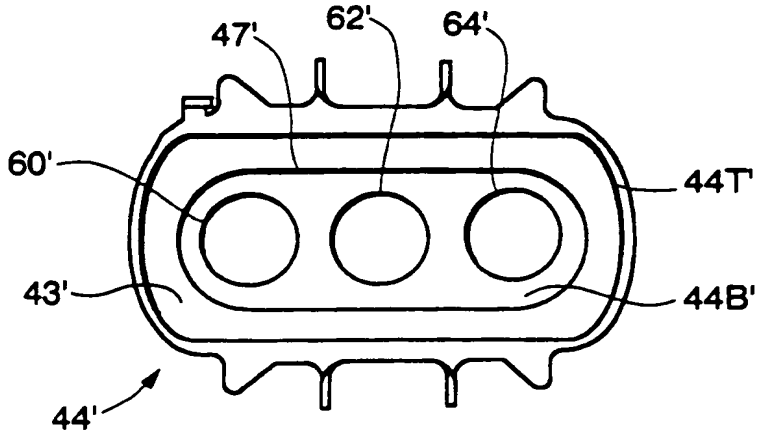


Fig. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 97 40 1593

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 429 252 A (VIELAND LEON J ET AL) * claims 1-3; figures 3,4 *	1	H01J29/50
A	US 4 172 309 A (CHIODI WAYNE R) * column 4, line 34 - line 59; claims 1-3 *	2	
A	US 4 406 970 A (HUGHES RICHARD H) * claim 1 *	1	
A	US 4 514 659 A (CHEN HSING-YAO) * claim 1 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

H01J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	11 December 1997	Van den Bulcke, E

CATEGORY OF CITED DOCUMENTS

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